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SEPTEMBER 12, 2016

HIGHLIGHTED ARTICLES

Species-specific responses to climate change and community composition determine future calcification rates of Florida Keys reefs
Global Change Biology (8.224)

Chemical and biological impacts of ocean acidification along the west coast of North America
Estuarine, Coastal and Shelf Science (2.057)

Coyote Unmanned Aircraft System observations in Hurricane Edouard (2014)
Earth and Space Science (n/a)

El Niño and coral larval dispersal across the eastern Pacific marine barrier
Nature Communications (10.742)

Ancestry and adaptive evolution of anadromous, resident, and adfluvial rainbow trout (*Oncorhynchus mykiss*) in the San Francisco Bay Area: Application of adaptive genomic variation to conservation in a highly impacted landscape
Evolutionary Applications (4.572)

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The National Earth System Prediction Capability: Coordinating the giant
Bulletin of the American Meteorological Society (11.57)

Seaglider surveys at Ocean Station Papa: Circulation and water mass properties in a meander of the North Pacific current
Journal of Geophysical Research (3.44)

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Assessing surface heat fluxes in atmospheric reanalyses with a decade of data from the NOAA Kuroshio Extension Observatory
Journal of Geophysical Research (3.44)

Risk analysis and bioeconomics of invasive species to inform policy and management
Annual Review of Environment and Resources (4.968)

ADDITIONAL ARTICLES

NMFS Publications

Building time-budgets from bioacoustic signals to measure population-level changes in behavior: A case study with sperm whales in the Gulf of Mexico
Ecological Indicators (3.230)

Dynamic social networks based on movement
Annals of Applied Statistics (2.24)

Evaluating the vulnerability to exploitation of an atypical protogynous hermaphrodite, black sea bass (*Centropristis striata*), by using a population simulation model
Fishery Bulletin (1.783)

Using gill nets and telemetry to track the activities of striped bass, bluefish, and weakfish at a salinity front in a small estuary
Fishery Bulletin (1.783)

OAR Publications

Development of MOST for real-time tsunami forecasting
Journal of Waterway, Port, Coastal, and Ocean Engineering (1.11)

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3-D water properties and geostrophic circulation on the eastern Bering Sea shelf
Deep Sea Research Part II (2.763)

Fine-scale spatial variation in ice cover and surface temperature trends across the surface of the Laurentian Great Lakes
Climatic Change (3.344)

A cross-scale view of N and P using a Bayesian hierarchical model
Limnology and Oceanography (3.62)

Watershed assessment with beach microbial source tracking and outcomes of resulting gull management
Environmental Science and Technology (5.481)

Changes in water quality variables at a mid-depth site after proliferation of dreissenid mussels in southeastern Lake Michigan
Fundamental and Applied Limnology (1.077)

The resolution dependence of contiguous U.S. precipitation extremes in response to CO_2 forcing
Journal of Climate (4.904)

Initializing HYSPLIT with satellite observations of volcanic ash: A case study of the 2008 Kasatochi eruption
Journal of Geophysical Research (3.44)

The influence of topography on convective storm environments in the eastern United States as deduced from the HRRR
Weather and Forecasting (1.972)

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[Modeling hypoxia in the central basin of Lake Erie under potential phosphorus load reduction scenarios]
Journal of Great Lakes Research (1.910)

[Extensive hydrothermal activity revealed by multi-tracer survey in the Wallis and Futuna region (SW Pacific)]
Deep Sea Research Part I (2.684)

HIGHLIGHTED ARTICLES

Species-specific responses to climate change and community composition determine future calcification rates of Florida Keys reefs
Global Change Biology (8.224)
R. R. Okazaki (OAR/PMEL), E. K. Towle, **R. van Hooidonk (OAR/AOML),** C. Mor, R. N. Winter, A. M. Piggot, R. Cunning, A. C. Baker, J. S. Klaus, P. K. Swart, C. Langdon

- This study demonstrates how species composition influences reef community responses to climate change and how reduced CO_2 emissions can limit future declines in reef calcification.

Anthropogenic climate change compromises reef growth as a result of increasing temperatures and ocean acidification. Scleractinian corals vary in their sensitivity to these variables, suggesting species composition will influence how reef communities respond to future climate change. Because data are lacking for many species, most studies that model future reef growth rely on uniform scleractinian calcification sensitivities to temperature and ocean acidification. In order to address this knowledge gap, calcification of twelve common and understudied Caribbean coral species was measured for two months under crossed temperatures (27°C, 30.3°C) and CO_2 partial pressures (pCO_2) (400, 900, 1300 μatm). Mixed effects models of calcification for each species were then used to project community-level scleractinian calcification using Florida Keys reef composition data and IPCC AR5 ensemble climate model data. Three of the four most abundant species - *Orbicella faveolata*, *Montastraea cavernosa*, and *Porites astreoides* - had

negative calcification responses to both elevated temperature and pCO_2. In the business-as-usual CO_2 emissions scenario, reefs with high abundances of these species had projected end-of-century declines in scleractinian calcification of >50% relative to present-day rates. *Siderastrea siderea*, the other most-common species, was insensitive to both temperature and pCO_2 within the levels tested here. Reefs dominated by this species had the most stable end-of-century growth. Under more optimistic scenarios of reduced CO_2 emissions, calcification rates throughout the Florida Keys declined <20% by 2100. Under the most extreme emissions scenario, projected declines were highly variable among reefs, ranging 10 to 100%. Without considering bleaching, reef growth will likely decline on most reefs, especially where resistant species like *S. siderea* are not already dominant. This study demonstrates how species composition influences reef community responses to climate change and how reduced CO_2 emissions can limit future declines in reef calcification.
Publication Date: 26 August 2016 (online)
Available online: http://onlinelibrary.wiley.com/doi/10.1111/gcb.13481/full

Chemical and biological impacts of ocean acidification along the west coast of North America
Estuarine, Coastal and Shelf Science (2.057)
R. A. Feely, S. Alin, B. Carter, N. Bednaršek, B. Hales, F. Chan, T. M. Hill, B. Gaylord, E. Sanford, R. H. Byrne, **C. L. Sabine, D. Greeley**, L. Juranek **(OAR/PMEL)**

- The coastal waters off the US West Coast are seasonally exposed to waters with low aragonite saturation.
- Large spatial differences in anthropogenic carbon occur in surface waters along the coast.
- Average surface anthropogenic carbon is almost twice the surface remineralized component.
- Uptake of anthropogenic carbon has caused the aragonite saturation horizon to shoal by approximately 30–50 m.

- Pteropod shell dissolution has increased approximately 20–25% since the pre-industrial era.

The continental shelf region off the west coast of North America is seasonally exposed to water with a low aragonite saturation state by coastal upwelling of CO_2-rich waters. To date, the spatial and temporal distribution of anthropogenic CO_2 (C_{anth}) within the CO_2-rich waters is largely unknown. Here we adapt the multiple linear regression approach to utilize the GO-SHIP Repeat Hydrography data from the northeast Pacific to establish an annually updated relationship between C_{anth} and potential density. This relationship was then used with the NOAA Ocean Acidification Program West Coast Ocean Acidification (WCOA) cruise data sets from 2007, 2011, 2012, and 2013 to determine the spatial variations of C_{anth} in the upwelled water. Our results show large spatial differences in C_{anth} in surface waters along the coast, with the lowest values (37–55 μmol kg^{-1}) in strong upwelling regions off southern Oregon and northern California and higher values (51–63 μmol kg^{-1}) to the north and south of this region. Coastal dissolved inorganic carbon concentrations are also elevated due to a natural remineralized component (C_{bio}), which represents carbon accumulated through net respiration in the seawater that has not yet degassed to the atmosphere. Average surface C_{anth} is almost twice the surface remineralized component. In contrast, C_{anth} is only about one third and one fifth of the remineralized component at 50 m and 100 m depth, respectively. Uptake of C_{anth} has caused the aragonite saturation horizon to shoal by approximately 30–50 m since the preindustrial period so that undersaturated waters are well within the regions of the continental shelf that affect the shell dissolution of living pteropods. Our data show that the most severe biological impacts occur in the nearshore waters, where corrosive waters are closest to the surface. Since the pre-industrial times, pteropod shell dissolution has, on average, increased approximately 20–25% in both nearshore and offshore waters.

Publication Date: 31 August 2016 (online)
Available online:
http://www.sciencedirect.com/science/article/pii/S0272771416302980

Coyote Unmanned Aircraft System observations in Hurricane Edouard (2014)
Earth and Space Science (n/a)
J. J. Cione (OAR/AOML), E. A. Kalina (OAR/AOML), E. W. Uhlhorn, A. M. Farber, **B. Damiano (AOC)**

- This paper describes the first successful air-deployed launch of an unmanned aircraft system into a mature hurricane.
- Data collected from the two Coyote unmanned aircraft missions conducted in Hurricane Edouard compared very favorably with conventional GPS dropsonde observations and flight level data collected from NOAA's P-3 aircraft.
- The study verifies the feasibility of small unmanned aircraft technology to observe the lowest altitudes in a hurricane, a data void region where critical processes driving intensity change occur.

Horizontal wind, temperature, and moisture observations are presented from two Coyote Unmanned Aircraft System (UAS) flights in the boundary layer of Hurricane Edouard (2014). The first flight sampled the meteorological conditions in the eye and eyewall at altitudes from 900-1500 m while Edouard was a major hurricane (105 kt) on 16 September 2014. The following day, a second Coyote sampled the inflow layer outside of the storm core at ~760 m altitude, when Edouard had weakened to an 80-kt hurricane. These flights represent the first deployments of a UAS from an airborne manned aircraft into a tropical cyclone. Comparisons between the Coyote data and the Lockheed WP-3D Orion (WP-3D) flight-level measurements and analyses constructed from dropsonde data are also provided. On 16 September 2014, the Coyote-measured horizontal wind speeds agree, on average, to within ~1 m s^{-1} of the wind speeds observed by the WP-3D, and reproduce the shape of the radial wind profile from the WP-3D measurements. For the inflow layer experiment on 17 September, the mean wind speeds from the Coyote and the dropsonde analysis differ by only 0.5 m s^{-1}, while the Coyote captured increased variability (σ=3.4 m s^{-1}) in the horizontal wind field compared to the dropsonde analysis (σ=2.2 m s^{-1}). Thermodynamic data from the Coyote and dropsondes agree well for both flights, with average discrepancies of 0.4 °C and

0.0 °C for temperature and 0.7 °C and 1.3 °C for dew point temperature on 16 and 17 September, respectively.
Publication Date: 8 September 2016 (online)
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2016EA000187/full

El Niño and coral larval dispersal across the eastern Pacific marine barrier
Nature Communications (10.742)
S. Wood, I. B. Baums, C. B. Paris, A. Ridgwell, **W. S. Kessler (OAR/PMEL)**, E. J. Hendy

- Results from a coral larval dispersal model driven by ocean current data from 1997-2011 show no eastward dispersal of coral larvae across the East Pacific Barrier during this period.
- Eastern Tropical Pacific coral populations decimated by 1998 bleaching event likely recovered in isolation from other regions.
- Dispersal patterns are highly sensitive to surface conditions in the equatorial Pacific, but significant complexity and variability in surface flows mean that generalized upper-ocean circulation patterns are poor descriptors of inter-regional connectivity.

More than 5,000 km separates the frequently disturbed coral reefs of the Eastern Tropical Pacific (ETP) from western sources of population replenishment. It has been hypothesized that El Niño events facilitate eastward dispersal across this East Pacific Barrier (EPB). Here we present a biophysical coral larval dispersal model driven by 14.5 years of high-resolution surface ocean current data including the extreme 1997–1998 El Niño. We find no eastward cross-EPB connections over this period, which implies that ETP coral populations decimated by the 1998 bleaching event can only have recovered from eastern Pacific sources, in congruence with genetic data. Instead, rare connections between eastern and central Pacific reefs are simulated in a westward direction. Significant complexity and variability in the surface flows transporting larvae mean that generalized upper-ocean circulation patterns are poor descriptors of inter-regional connectivity, complicating the assessment of how climate change will impact coral gene flow Pacific wide.
Publication Date: 23 August 2016

NOAA SCIENTIFIC PUBLICATIONS REPORT
SEPTEMBER 12, 2016

Available online:
http://www.nature.com/ncomms/2016/160823/ncomms12571/full/ncomms12571.html

Ancestry and adaptive evolution of anadromous, resident, and adfluvial rainbow trout (Oncorhynchus mykiss) *in the San Francisco Bay Area: application of adaptive genomic variation to conservation in a highly impacted landscape*
Evolutionary Applications (4.572)
M. Leitwein, **J. C. Garza**, **D. E. Pearse (NMFS/SWFSC)**

- Genetic analysis determined that almost all trout populations in tributaries of the San Francisco Bay Area are of native ancestry, with very little introgression by hatchery rainbow trout.
- Adaptive genomic variation associated with migratory life history traits in trout shows substantial evolutionary differences between fish above and below dams.
- A strong relationship between reservoir volume below landlocked trout populations and the frequency of genetic variants associated with anadromy suggests that large reservoirs can support adfluvial trout populations and maintain genetic variation associated with migratory behavior.
- These findings have direct impacts on the restoration, conservation, and landscape management of the San Francisco Bay area.

The streams draining into San Francisco Bay, California, have been impacted by habitat alteration for over 150 years, and roads, dams, water diversions, and other impediments now block the paths of many aquatic migratory species. These changes can affect the genetic structure of fish populations, as well as driving adaptive evolution to novel environmental conditions. Here we determine the evolutionary relationships of San Francisco Bay Area steelhead/rainbow trout (*Oncorhynchus mykiss*) populations and show that 1) they are more closely related to native coastal steelhead than to the California Central Valley lineage, with no evidence of introgression by domesticated hatchery rainbow trout, 2) populations above and below barriers within watersheds are each other's closest relatives, and 3) adaptive genomic variation associated with migratory life history traits in *O.*

mykiss shows substantial evolutionary differences between fish above and below dams. These findings support continued habitat restoration and protection of San Francisco Bay Area *O. mykiss* populations and demonstrate that ecological conditions in novel habitats above barriers to anadromy influence life history evolution. We highlight the importance of considering the adaptive landscape in conservation and restoration programs for species living in highly modified habitats, particularly with respect to key life-history traits.
Publication Date: 26 August 2016 (online)
Available online: http://onlinelibrary.wiley.com/doi/10.1111/eva.12416/pdf

CROSS LINE OFFICE ARTICLES

The National Earth System Prediction Capability: Coordinating the giant
Bulletin of the American Meteorological Society (11.57)
J. C. Carman (OAR/OWAQ), D. P. Eleuterio, T. C. Gallaudet, G. L. Geernaert, P. A. Harr, J. A. Kaye, D. H. McCarren, **C. N. McLean (OAR),** S. A. Sandgathe, **F. Toepfer (NWS/OSTI)**, **L. W. Uccellini (NWS)**

- This paper describes a five-agency strategy to coordinate and accelerate the national numerical environmental prediction capability.

The U.S. has had three operational numerical weather prediction centers since the Joint Numerical Weather Prediction Unit was closed in 1958. This led to separate paths for U.S. numerical weather prediction, research, technology and operations resulting in multiple community calls for better coordination. Since 2006, the three operational organizations, Air Force, Navy and NWS, and more recently, DOE, NASA, the National Science Foundation (NSF), and NOAA OAR, have been working to increase coordination. This increasingly successful effort has resulted in the establishment of a National Earth System Prediction Capability (National ESPC) office with responsibility to further inter-agency coordination and collaboration. It has also resulted in sharing of data through an operational global ensemble, common software standards, and model components among the agencies. This article discusses the drivers, the progress, and the future of interagency collaboration.

NOAA SCIENTIFIC PUBLICATIONS REPORT
SEPTEMBER 12, 2016

Publication Date: 1 August 2016 (online)
Available online: http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-16-0002.1

Seaglider surveys at Ocean Station Papa: Circulation and water mass properties in a meander of the North Pacific current
Journal of Geophysical Research (3.44)
N. A. Pelland (NMFS/AKFSC), C. C. Eriksen, **M. F. Cronin (OAR/PMEL)**

- This study reports on North Pacific circulation patterns using data from Seaglider autonomous underwater vehicle surveys at Ocean Station Papa.

A Seaglider autonomous underwater vehicle augmented the Ocean Station Papa (OSP; 50°N, 145°W) surface mooring, measuring spatial structure on scales relevant to the monthly evolution of the moored time series. During each of three missions from June 2008–January 2010, a Seaglider made biweekly 50 km × 50 km surveys in a bowtie-shaped survey track. Horizontal temperature and salinity gradients measured by these surveys were an order of magnitude stronger than climatological values and sometimes of opposite sign. Geostrophically-inferred circulation was corroborated by moored acoustic Doppler current profiler measurements and AVISO satellite altimetry estimates of surface currents, confirming that glider surveys accurately resolved monthly-scale mesoscale spatial structure. In contrast to climatological North Pacific Current circulation, upper ocean flow was modestly northward during the first half of the 18 month survey period, and weakly westward during its latter half, with Rossby number O (0.01). This change in circulation coincided with a shift from cool and fresh to warm, saline, oxygen-rich water in the upper-ocean halocline, and an increase in vertical finestructure there and in the lower pycnocline. The anomalous flow and abrupt water mass transition were due to the slow growth of an anticyclonic meander within the North Pacific Current with radius comparable to the scale of the survey pattern, originating to the southeast of OSP.
Publication Date: 24 August 2016 (online)
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2016JC011920/full

Assessing surface heat fluxes in atmospheric reanalyses with a decade of data from the NOAA Kuroshio Extension Observatory
Journal of Geophysical Research (3.44)
D. Zhang (OAR/PMEL), M. F. Cronin (OAR/PMEL), C. Wen (NWS/NCEP), Y. Xue (NWS/NCEP), A. Kumar (NWS/NCEP), D. McClurg (OAR/PMEL)

- The authors assessed two new reanalysis products for their ability to produce measured heat flux.
- The two products improve estimates of all four flux components (sensible and latent heat flux and net longwave and shortwave radiation), however errors remain of the net surface heat flux.

Previous studies have found large biases and uncertainties in the air-sea fluxes from Numerical Weather Prediction model reanalyses. These must be identified and reduced in order to improve weather and climate predictions. Here, air-sea heat fluxes from NOAA Kuroshio Extension Observatory (KEO) measurements are used to assess two new reanalyses, NCEP's Climate Forecast System Reanalysis (CFSR) and ECMWF Reanalysis-Interim (ERA-I), suggesting that these two new generation reanalyses represent significant improvements. In both reanalyses, all four flux components (sensible and latent heat flux and net longwave and shortwave radiation) are highly correlated with observation, with the correlation of total net surface heat fluxes above 0.96. Although errors of the net surface heat flux have significantly reduced from previous reanalyses, the Root Mean Square Errors (RMSEs) and biases remain high especially for CFSR: the RMSEs of CFSR and ERA-I are reduced by 25-30% to 64 and 61 W/m^2, respectively, while biases are reduced by 40-60% to 28 and 20 W/m^2. But CFSR overestimates the winter heat release by 90 W/m^2. The main cause of biases is the latent heat flux, while RMS errors are primarily due to latent heat flux and shortwave radiation errors. Both reanalyses overestimate the wind speed associated with winter storms and underestimate specific humidity in summer. The ERA-I latent heat flux, and its total net surface heat flux, are however closer to observation. It is the bulk algorithm in CFSR that is found to be mainly responsible for overestimates of winter heat release in CFSR.

Publication date: 2 September 2016 (online)
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2016JC011905/full

Risk analysis and bioeconomics of invasive species to inform policy and management

Annual Review of Environment and Resources (4.968)

D. M. Lodge, P. W. Simonin, S. W. Burgiel, R. P. Keller, J. M. Bossenbroek, C. L. Jerde, A. M. Kramer, **E. S. Rutherford (OAR/GLERL)**, M. A. Barnes, M. E. Wittmann, W. L. Chadderton, J. L. Apriesnig, **D. Beletsky (OAR/GLERL)**, R. Cooke, J. M. Drake, S. P. Egan, D. C. Finnoff, C. A. Gantz, E. K. Grey, M. H. Hoff, J. G. Howeth, R. A. Jensen, E. R. Larson, N. E. Mandrak, D. M. Mason, F. **A. Martinez (NOS/NCCOS)**, T. J. Newcomb, J. D. Rothlisberger, A. J. Tucker, T. W. Warziniack, **H. Zhang (OAR/GLERL)**

- This review discusses recent research exploring connections between biological and economic impacts of invasive species.
- Prevention of invasive species results in the greatest long term benefit.

Research on species invasions conceptually and quantitatively links biology and economics, and enables improved policy and management of invasive species. Large financial burdens imposed by invasive species motivate science-based international and national policies. Risk assessments for intentionally imported species deliver net increases in social welfare. Forecasts of species dispersal facilitate geographically explicit priorities for surveillance programs, which are enhanced by new tools (e.g., eDNA), and improved mapping of potential habitat. Bioeconomic models account for the interacting dynamics within and between ecological and economic systems, and allow decision makers to better understand the financial consequences of alternative management strategies. Expert elicitation and other new methods to quantify and communicate uncertainty focus attention on management alternatives that are robust to the large remaining uncertainties. In general, recent research advances demonstrate that prevention is the most effective policy and the one with the greatest long-term net benefit.

Expected Publication Date: 17 October 2016

Available online: http://www.annualreviews.org/doi/abs/10.1146/annurev-environ-110615-085532

ADDITIONAL ARTICLES

NMFS Publications

Building time-budgets from bioacoustic signals to measure population-level changes in behavior: A case study with sperm whales in the Gulf of Mexico
Ecological Indicators (3.230)
E. M. McDonald, J. L. Morano, **A. I. DeAngelis (NMFS/NEFSC)**, A. N. Rice

- This paper describes a wide-scale acoustic approach to assess areas of particular behaviors of vocalizing species.
- The metrics can be viewed long-term to see if changes in behavior have occurred over discrete spatial scales.

Evaluating changes in the collective behavior of a population can be an indirect method for inferring organismal responses to changing environmental conditions. Apex predators such as the sperm whale *(Physeter macrocephalus),* can provide valuable insights into the ecosystem processes of the deep sea, where little direct observation can be made. Sperm whales are often difficult to observe at sea, as they inhabit deep, offshore waters and spend most of their lives beneath the surface. However, sperm whales are extremely amenable to passive acoustic monitoring, as their vocalizations are well-studied, highly distinguishable, produced regularly, and can be detected at relatively long ranges (>10 km). Sperm whales produce distinct clicks in two behavioral contexts (social interaction or foraging/prey capture); thus, we can use acoustic detection of these vocalizations to infer patterns of large-scale, collective behavior, which is similar to studying calling frogs or insects indicating their reproductive phenology. We recorded behaviorally-specific sperm whale vocalizations at three sites in the Northern Gulf of Mexico in July 2010 and 2011. We used these recordings to construct population-level time budgets, an empirical collective metric of behavior, based on the ratio of hours in a day with social clicks to the hours in a day with foraging

clicks, and represented this as an "acoustic activity index." Our index showed significant differences in the proportions of social and foraging behavior across the range of sperm whales in the Northern Gulf of Mexico, and the proportion of social activity increased by more than a factor of two from 2010 to 2011. These differences support previous evidence of differential habitat use by sperm whales in the Gulf of Mexico, and suggest possible changes in environmental conditions between years. Thus, the acoustic activity index may provide a powerful way to evaluate changes in behavior and link them to changing ecological conditions. This novel application of bioacoustics to constructing time budgets and creating a behaviorally-based index at the population scale can serve as an indicator of ecological change, and greatly enhance our ability to understand the behavior and ecology of many acoustically active species.
Publication Date: 3 September 2016 (online)
Available online:
http://www.sciencedirect.com/science/article/pii/S1470160X16304897

Dynamic social networks based on movement
Annals of Applied Statistics (2.24)
H. Scharf, M. Hooten, B. Fosdick, D. Johnson, J. London, **J. Durban (NMFS/SWFSC)**

- Novel statistical method to infer social networks from movement data.
- Description of Antarctic killer whale social dynamics from telemetry data.

Network modeling techniques provide a means for quantifying social structure in populations of individuals. Data used to define social connectivity are often expensive to collect and based on case-specific and ad hoc criteria. Moreover, in applications involving animal social networks, collection of these data is often opportunistic and can be invasive. Frequently, the social network of interest for a given population is closely related to the way individuals move. Thus telemetry data, which are minimally-invasive and relatively inexpensive to collect, present an alternative source of information. We develop a framework for using telemetry data to infer social relationships among animals. To achieve this, we propose a

Bayesian hierarchical model with an underlying dynamic social network controlling movement of individuals via two mechanisms: an attractive effect, and an aligning effect. We demonstrate the model and its ability to accurately identify complex social behavior in simulation, and apply our model to telemetry data arising from killer whales. Using auxiliary information about the study population, we investigate model validity and find the inferred dynamic social network is consistent with killer whale ecology and expert knowledge.
Accepted: 12 August 2016

Evaluating the vulnerability to exploitation of an atypical protogynous hermaphrodite, black sea bass (Centropristis striata), *by using a population simulation model*
Fishery Bulletin (1.783)
J. Blaylock and G. R. Shepherd (NMFS/NEFSC)

- This work provides new insight into the response of protogynous species to exploitation.
- Stocks exhibiting atypical protogynous characteristics (such as the northern stock of black sea bass) may be more resilient to exploitation than typical protogynous hermaphrodites.
- Results highlight the need for a better understanding of factors that govern key processes (e.g., sex change, secondary male spawning, recruitment) in protogynous species in general and in black sea bass in particular.

Fish species that are protogynous hermaphrodites generally have sex ratios skewed toward males at large sizes. These skewed sex ratios at length can make a stock more vulnerable to overexploitation, particularly in fisheries where minimum size is regulated, resulting in a removal of reproductively active males. We developed a length-based population model to test the vulnerability to exploitation of a population with an atypical protogynous life history, in particular the northern stock of black sea bass (*Centropristis striata*). Black sea bass north of Cape Hatteras, North Carolina, are unusual for protogynous species in that they may undergo prematurational transformation, remain female at large sizes, involve secondary males in spawning, and undertake seasonal migrations. The model was

developed to examine the impact of participation by secondary males in population productivity, the influence of size at sex transformation, and the subsequent robustness of the population under exploitation, compared with equivalent gonochoristic and typical protogynous populations. Although the model does not capture all the dynamics of a population, such as density-dependent regulation of sex transformation, our results indicate that the northern stock of black sea bass may be more resilient in response to exploitation than would be expected if they were typical protogynous hermaphrodites.
Accepted: 19 August 2016

Using gill nets and telemetry to track the activities of striped bass, bluefish, and weakfish at a salinity front in a small estuary
Fishery Bulletin (1.783)
L. L. Stehlik, J. P. Manderson, J. Pessutti (NMFS/NEFSC)

- The presence of a salinity transition zone or front did not affect the distribution of striped bass, bluefish and weakfish, three well-documented competitors for food and space.
- This study represents the first simultaneous use of ultrasonic tags with these three species.

The development and dispersal of a salinity transition zone or front in a small New Jersey estuary from May through October of 2007 was monitored. The hypothesis, that the distributions of striped bass (*Morone saxatilis)*, bluefish (*Pomatomus saltatrix)*, and weakfish *(Cynoscion regalis*) and forage fish would be strictly associated with the front, was not supported. A station at the salinity front and another in a nearby deeper channel were sampled weekly by gill nets. Regardless of the presence or absence of the front, predators' abundance was significantly different at the two stations, weakfish mainly in the channel and bluefish mainly at the front. Forage fish were collected at both stations, and the diets of bluefish and weakfish overlapped in all seasons. Ultrasonically tagged striped bass, weakfish, and bluefish were tracked concurrently throughout May through October 2007. The tagged predators occupied home ranges 1.5-2.5 km in length for days to several weeks. Mean daily home ranges, or utilization distributions (UD), of

striped bass occurred upriver and also near the mouth (km 1). Mean UDs of weakfish were located in the midriver channels, while those of age-1+ bluefish were located midriver and upriver, from km 5-11. Mean UDs of age-0 bluefish encompassed the salinity transition zone from km 8-11. The three species' mean daily home ranges were not limited to the area of the salinity front, contrary to the initial hypothesis.
Accepted: 11 August 2016

OAR Publications

Development of MOST for real-time tsunami forecasting
Journal of Waterway, Port, Coastal, and Ocean Engineering (1.11)
V. V. Titov, U. Kânoğlu, C. Synolakis **(OAR/PMEL)**

- This review covers the development and implementation of the method of splitting tsunami (MOST) model, now used as the operational forecast model for NOAA's Tsunami Warning System.

The development, testing, and implementation of a real-time tsunami forecast model, the method of splitting tsunami (MOST), is described. MOST is now used as an operational forecast model for the National Oceanic and Atmospheric Administration's Tsunami Warning System, and as a tsunami hazard assessment tool in the United States and in many countries around the world. Every step in the development of MOST marked new scientific challenges, improvements of technological and computational capabilities, and new demands of the engineering and hazard mitigation communities for applied and benchmark modeling tools for tsunami hazard assessment.
Publication Date: 17 August 2016
Available online: http://ascelibrary.org/doi/abs/10.1061/(ASCE)WW.1943-5460.0000357

3-D water properties and geostrophic circulation on the eastern Bering Sea shelf
Deep Sea Research Part II (2.763)
E. D. Cokelet (OAR/PMEL)

- This study reports on data collected by conductivity-temperature-depth (CTD) instruments added to net hauls during regular bottom trawl surveys on the eastern Bering Sea continental shelf from 2008-2010.
- Measurements on a regular three-dimensional grid provide unique insight into the thermohaline structure in this region.

The National Oceanic and Atmospheric Administration's (NOAA) Alaska Fisheries Science Center bottom trawl survey samples demersal fish at over 350 sites on the eastern Bering Sea continental shelf each summer on a 37×37 km^2 grid. Rugged conductivity–temperature-depth sensors (CTDs) were added to the net hauls to obtain gridded data sets of temperature and salinity measurements for 2008–2010. Results reveal the three-dimensional thermohaline structure of the shelf including the Cold Pool and areas of fresher water around St. Matthew Island and in Bristol Bay. Horizontal gradients are often strongest roughly along the 50-m and 100-m isobaths that traditionally separate the inner- and outer-shelf from the middle-shelf centered along the 70-m isobath. The summer mixed layer depth is less than 30 m over much of the region. It reaches the bottom along the Alaska Peninsula in water depths greater than 70 m, showing that the boundary of the well-mixed, inner shelf is not always at the 50-m isobath. The greatest upper-to-lower layer density difference is found across the shelf north of 59°N. The salinity difference is the main contributor to this density difference over most of the region in 2008 and 2010, but the temperature difference dominates in 2009 due to decreased ice melt and reduced freshening near St. Matthew Island. The geostrophic velocity relative to the bottom shows northwestward flow seaward of the 100-m isobath and northwestward transports integrated across the shelf of 0.10–0.25×106 m^3/s. In 2008 and 2010 there was clockwise circulation in a region of less-saline water around St. Matthew Island. In 2009 that fresher lens did not exist, and flow was more concentrated along the 100-m isobath bringing saltier water across the shelf.

Publication Date: 21 August 2016 (online)
Available online:
http://www.sciencedirect.com/science/article/pii/S0967064516302314

NOAA SCIENTIFIC PUBLICATIONS REPORT
SEPTEMBER 12, 2016

Fine-scale spatial variation in ice cover and surface temperature trends across the surface of the Laurentian Great Lakes

Climatic Change (3.344)

L. A. Mason, C. M. Riseng, **A. D. Gronewold, E. S. Rutherford, J. Wang, A. Clites**, S. D. P. Smith, P. B. McIntyre **(OAR/GLERL)**

- At the lake sub-basin scale, statistical models identify distinct warming trends within each lake that included significant breakpoints in ice duration for the 13 sub-basins, consistent linear declines in 11 sub-basins, and no trend in 3 sub-basins.
- The northern and easternmost portions of each Great Lake, especially in nearshore areas, have experienced faster rates of warming and shortening ice duration than previously reported based on lake-scale analysis.

The effects of climate change on north temperate freshwater ecosystems include increasing water temperatures and decreasing ice cover. Here we compare those trends in the Laurentian Great Lakes at three spatial scales to evaluate how warming varies across the surface of these massive inland water bodies. We compiled seasonal ice cover duration (1973–2013) and lake summer surface water temperatures (LSSWT; 1994–2013), and analyzed spatial patterns and trends at lake-wide, lake sub-basin, and fine spatial scales and compared those to reported lake- and basin-wide trends. At the lake-wide scale we found declining ice duration and warming LSSWT patterns consistent with previous studies. At the lake sub-basin scale, our statistical models identified distinct warming trends within each lake that included significant breakpoints in ice duration for 13 sub-basins, consistent linear declines in 11 sub-basins, and no trends in 4 sub-basins. At the finest scale, we found that the northern- and eastern-most portions of each Great Lake, especially in nearshore areas, have experienced faster rates of LSSWT warming and shortening ice duration than those previously reported from trends at the lake scale. We conclude that lake-level analyses mask significant spatial and temporal variation in warming patterns within the Laurentian Great Lakes. Recognizing spatial variability in rates of change can inform both mechanistic

modeling of ecosystem responses and planning for long-term management of these large freshwater ecosystems.
Publication Date: September 2016
Available online: http://link.springer.com/article/10.1007/s10584-016-1721-2

A cross-scale view of N and P using a Bayesian hierarchical model
Limnology and Oceanography (3.62)
Y. K. Cha, I. M. Alameddine, S. S. Qian, **C. A. Stow (OAR/GLERL)**

- Summary statistics representing N and P concentrations and the N:P ratio can be misleading; the authors present an approach to give a more representative view.
- Nutrient dynamics are fundamental to coastal HABs and hypoxia.

We propose a bivariate Bayesian hierarchical model (BBHM), which adds a perspective on a century-long subject of research, nitrogen (N) and phosphorus (P) dynamics in freshwater and coastal marine ecosystems. The BBHM is differentiated from existing approaches by modeling multiple aspects of N-P relationships-N and P concentration variability, ratio, and correlation-simultaneously, allowing these aspects to vary by seasonal and/or spatial components. The BBHM is applied to three aquatic systems, Finnish Lakes, Saginaw Bay, and the Neuse Estuary, which exhibit differing landscapes and complexity of nutrient dynamics. Our model reveals N and P dynamics that are critical to inferring unknown N and P distributions for the overall system as well as for within system variability. For Finnish lakes, strong positive within- and among-lake N and P correlations indicate that the rates of N and P biogeochemical cycles are closely coupled during summer across the different lake categories. In contrast, seasonal decoupling between N and P cycles in Saginaw Bay is evidenced by the large variability in monthly correlations and the seasonal changes in the N distribution. The results underscore the pivotal role that dreissenids have had on the cycling of nutrients and resurgence of eutrophication. The presence of clear seasonality and a spatial gradient in the distributions and N and P in the Neuse Estuary suggest that riverine N input is an important source in the season-space N

dynamics, while summer sediment release is a major process regulating seasonal P distribution.
Publication Date: 3 August 2016 (online)
Available online: http://onlinelibrary.wiley.com/doi/10.1002/lno.10375/full

Watershed assessment with beach microbial source tracking and outcomes of resulting gull management
Environmental Science and Technology (5.481)
K. D. Goodwin, S. Gruber, M. Vondrak, A. Crumpacker **(OAR/AOML)**

- Application of the AOML-developed test for gull fecal contamination provided actionable information that led to successful management action.
- AOML research informed a very inexpensive and successful management solution, saving resources and improving beach and water quality.

Total maximum daily load (TMDL) implementation at a southern California beach involved ultraviolet treatment of watershed drainage that provided >97% reduction in fecal indicator bacteria (FIB) concentrations. However, this pollutant control measure did not provide sufficient improvement of beach water quality, prompting further assessment. Investigation included microbial source tracking (MST) for human, gull, and canine fecal sources, monitoring of enterococci and fecal coliform, and measurement of chemical and physical water quality parameters for samples collected from watershed, groundwater, and beach sites, including a beach scour pond and tidal creek. FIB variability remained poorly modeled in regression analysis. However, MST revealed correlations between FIB and gull source tracking markers, leading to recommendations to manage gulls as a pollutant source. Beach conditions were followed for three years after implementation of a best management practice (BMP) to abate gulls using a falconry program for the beach and an upland landfill. The gull abatement BMP was associated with improved beach water quality, and this appears to be the first report of falconry in the context of TMDL implementation. Overall, MST data enabled management action despite an inability to fully model FIB dynamics in the coupled watershed–beach system.
Publication Date: 18 August 2016 (online)

NOAA SCIENTIFIC PUBLICATIONS REPORT
SEPTEMBER 12, 2016

Available online: http://pubs.acs.org/doi/abs/10.1021/acs.est.6b02564

Changes in water quality variables at a mid-depth site after proliferation of dreissenid mussels in southeastern Lake Michigan
Fundamental and Applied Limnology (1.077)
S. A. Pothoven, G. L. Fahnenstiel, **H. A. Vanderploeg**, T. F. Nalepa
(OAR/GLERL)

- Mid depth coastal regions of the Great Lakes are understudied with regards to invasive mussel impact on food web dynamics.
- This study examines changes in the lower food web from 1995-2014 finding a decline in chlorophyll-a, an increase in water clarity, and a decrease in phosphorus at mid depths in coastal regions.
- The patterns observed at the mid depth matches those found in the deeper depths of Lake Michigan.

Studies evaluating the impacts of dreissenid mussels in Lake Michigan have largely focused on changes in phytoplankton dynamics in the offshore region (i.e., > 100 m depth) even though mussel biomass is actually highest in mid-depth coastal regions of Lake Michigan (i.e., 30 – 50 m). Here we report on changes at the base of the food web during 1995 – 2014 at a mid-depth site located in southeastern Lake Michigan. Specifically, we evaluated trends in Secchi depth, surface mixed layer chlorophyll-a and total phosphorus (TP), sub-epilimnetic deep chlorophyll layer concentrations, and near bottom chlorophyll-a concentrations and whether there have been shifts in the seasonal patterns of these variables. Median chlorophyll-a concentrations declined over 63 % during the spring isothermal period following the sharp increase in mussel abundance between 1996 – 2002 and 2007– 2014. Chlorophyll-a concentrations in the spring were generally between 2 and 3 mg m^{-3} in 1996 – 2002, but almost never exceeded 1 mg m^{-3} in 2007– 2014. Secchi depths increased in all months between 1996 – 2002 and 2007– 2014, with the greatest changes being observed in the spring. Total phosphorus in the surface mixed layer declined over the study period, but not at as fast a rate as chlorophyll-a, a change consistent with mussel invasions. There was a 90 % decline in the median depth integrated deep chlorophyll-a concentration between 1995 – 2000

and 2007– 2014 in June when this feature was at its peak. Chlorophyll-a concentrations in the near bottom zone also decreased over time, likely due to their constant contact with dreissenid mussels. The declines in chlorophyll-a and changes in nutrient dynamics at the mid-depth site are consistent with dreissenid induced impacts that have also been documented at deeper, offshore sites in Lake Michigan.
Publication Date: 1 August 2016
Available Online:
https://www.schweizerbart.de/papers/fal/detail/188/86612/Changes_in_water_quality_variables_at_a_mid_depth_site_after_proliferation_of_dreissenid_mussels_in_southeastern_Lake_Michigan?l=EN

The resolution dependence of contiguous U.S. precipitation extremes in response to CO_2 forcing
Journal of Climate (4.904)
K. van der Wiel, S. B. Kapnick, G. A. Vecchi, W. F. Cooke, T. L. Delworth, L. Jia, H. Murakami, S. Underwood, F. Zeng (OAR/GFDL)

- This study employed three newly developed global coupled climate models to study the impact of horizontal atmospheric model resolution (tile size) on precipitation extremes under higher atmospheric CO_2 concentrations.
- Results show that higher-resolution models significantly improve the simulation of mean precipitation, the distribution of precipitation, and spatial patterns, intensity and seasonality of precipitation extremes.

Precipitation extremes have a widespread impact on societies and ecosystems; it is therefore important to understand current and future patterns of extreme precipitation. Here, a set of new global coupled climate models with varying atmospheric resolution has been used to investigate the ability of these models to reproduce observed patterns of precipitation extremes and to investigate changes in these extremes in response to increased atmospheric CO_2 concentrations. The atmospheric resolution was increased from 2°×2° grid cells (typical resolution in the CMIP5 archive) to 0.25°×.25° (tropical cyclone-permitting). Analysis has been

confined to the contiguous United States (CONUS). It is shown that, for these models, integrating at higher atmospheric resolution improves all aspects of simulated extreme precipitation: spatial patterns, intensities and seasonal timing. In response to $2\times CO_2$ concentrations, all models show a mean intensification of precipitation rates during extreme events of approximately 3-4% K^{-1}. However, projected regional patterns of changes in extremes are dependent on model resolution. For example, the highest-resolution models show increased precipitation rates during extreme events in the hurricane season in the CONUS southeast, this increase is not found in the low-resolution model. These results emphasize that, for the study of extreme precipitation there is a minimum model resolution that is needed to capture the weather phenomena generating the extremes. Finally, the observed record and historical model experiments were used to investigate changes in the recent past. In part because of large intrinsic variability, no evidence was found for changes in extreme precipitation attributable to climate change in the available observed record.
Publication Date: 8 August 2016 (online)
Available online: http://journals.ametsoc.org/doi/10.1175/JCLI-D-16-0307.1

Initializing HYSPLIT with satellite observations of volcanic ash: A case study of the 2008 Kasatochi eruption
Journal of Geophysical Research (3.44)
A. Crawford, **B. Stunder**, **F. Ngan**, **M. Pavolonis (OAR/ARL)**

- New satellite products, which give the location, mass loading, top height and effective radius of a volcanic ash cloud, can be used to improve volcanic ash forecasts made by the HYSPLIT transport and dispersion model.
- Accurate forecasts of the location of volcanic ash are important to ensure the safety of aircraft and minimize impacts to travelers and the aviation industry.

The current work focuses on improving volcanic ash forecasts by integrating satellite observations of ash into the Lagrangian transport and dispersion model, HYSPLIT. The accuracy of HYSPLIT output is dependent on the accuracy of the initialization: the initial position, size distribution and amount of ash as a function

of time. Satellite observations from passive infrared, IR, sensors are used both to construct the initialization term and for verification. Space-based lidar observations are used for further verification. We compare model output produced using different initializations for the 2008 eruption of Kasatochi in the Aleutian Islands. Simple source terms, such as a uniform vertical line or cylindrical source above the vent, are compared to initializations derived from satellite measurements of position, mass loading, effective radius and height of the downwind ash cloud. Using satellite measurements of column mass loading of ash to constrain the source term produces better long term predictions than using an empirical equation relating mass eruption rate and plume height above the vent. Even though some quantities, such as the cloud thickness, must be estimated, initializations which release particles at the position of the observed ash cloud produce model output which is comparable to or better than the model output produced with source terms located above and around the vent. Space-based lidar data, passive IR retrievals of ash cloud top height, and model output agree well with each other, and all suggest that the Kasatochi ash cloud evolved into a complex three dimensional structure.
Publication Date: 1 September 2016 (online)
Available online: http://onlinelibrary.wiley.com/doi/10.1002/2016JD024779/full

The influence of topography on convective storm environments in the eastern United States as deduced from the HRRR
Weather and Forecasting (1.972)
B. Katona, P. Markowski, **C. Alexander**, **S. Benjamin (OAR/ESRL/GSD**)

- The High-Resolution Rapid Refresh (HRRR) model was used to study how topography affects convective storms.

Relatively little is known about how topography affects convective storms. The first step toward understanding these effects is to investigate how topography affects storm environments. Unfortunately, the effects of topography on convective environments is not easily observed directly. Instead, we resort to using output from the High-Resolution Rapid Refresh (HRRR). The HRRR's 3-km grid spacing can resolve some of the larger scale topographic effects. Popular convective storm forecasting parameters obtained from the HRRR are averaged on convective days

from February-September, 2013–2015. It is surmised that most of the day-to-day variability attributable to synoptic- and mesoscale meteorological influences is removed by averaging; the remaining horizontal heterogeneity in parameters related to instability and vertical wind shear is due to the hemispheric-scale meridional temperature and pressure gradient, and likely also topographic influences, especially where recurring longitudinal variations in instability, wind shear, etc., are found. Anomalies are sensitive to the ambient low-level wind direction (i.e., whether winds are locally blowing upslope or downslope), especially for parameters that depend on the low-level vertical shear. Statistical significance of local maxima and minima is demonstrated by comparing the amplitudes of the anomalies to bootstrapped estimates of the standard errors
Publication Date: 26 July 2016 (online)
Available online: http://journals.ametsoc.org/doi/abs/10.1175/WAF-D-16-0038.1?af=R

Modeling hypoxia in the central basin of Lake Erie under potential phosphorus load reduction scenarios
Journal of Great Lakes Research (1.910)
D. K. Rucinski, J. V. DePinto, **D. Beletsky**, D. Scavia **(OAR/GLERL)**

- Our analysis demonstrated that while reductions in total phosphorus loads can be expected to reduce hypoxia and chlorophyll-a impairments on average, climate and meteorological variability will result in significant year to year variability.
- We provide examples for achieving hypothetical water quality goals and relate the required reductions to recent nutrient sources.
- The results were part of the effort that guided the setting of new phosphorus loading targets in accordance with the Great Lakes Water Quality Agreement.

A 1-dimensional (vertical), linked hydrodynamic and eutrophication model that was previously calibrated and corroborated with 19 years (1987–2005) of observations in the central basin of Lake Erie, was applied as part of a group of models capable of forecasting ecosystem responses to altered phosphorus loads to

Lake Erie. The results were part of the effort guiding the setting of new phosphorus loading targets in accordance with the Great Lakes Water Quality Agreement. Our analysis demonstrated that while reductions in total phosphorus loads can be expected to reduce hypoxia and chlorophyll-a impairments on average, climate and meteorological variability will result in significant year to year variability. We provide examples for achieving hypothetical water quality goals and relate the required reductions to recent nutrient sources.
Publication Date: 25 July 2016 (online)
Available online:
http://www.sciencedirect.com/science/article/pii/S0380133016300971

Extensive hydrothermal activity revealed by multi-tracer survey in the Wallis and Futuna region (SW Pacific)
Deep Sea Research Part I (2.684)
C. Konn, E. Fourré, P. Jean-Baptiste, J. P. Donval, V. Guyader, D. Birot, A. S. Alix, A. Gaillot, F. Perez, A. Dapoigny, E. Pelleter, **J. A. Resing**, J. L. Charlou, Y. Fouquet, scientific parties **(OAR/PMEL)**

- SW Pacific is characterized by extensive and diverse hydrothermal activity.
- Futuna Spreading Center (FSC) sets the western boundary of the hydrothermally active region.
- Results support the importance of back-arc hydrothermal systems for global ocean chemistry and biogeochemical cycles.

The study area is close to the Wallis and Futuna Islands in the French EEZ. It exists on the western boundary of the fastest tectonic area in the world at the junction of the Lau and North-Fiji basins. At this place, the unstable back-arc accommodates the plate motion in three ways: (i) the north Fiji transform fault, (ii) numerous unstable spreading ridges, and (iii) large areas of recent volcanic activity. This instability creates bountiful opportunity for hydrothermal discharge to occur. Based on geochemical (CH_4, TDM, ^3He) and geophysical (nephelometry) tracer surveys: (1) no hydrothermal activity could be found on the Futuna Spreading Centre (FSC) which sets the western limit of hydrothermal activity; (2) four distinct hydrothermal active areas were identified: Kulo Lasi Caldera,

Amanaki Volcano, Fatu Kapa and Tasi Tulo areas; (3) extensive and diverse hydrothermal manifestations were observed and especially a 2D distribution of the sources. At Kulo Lasi, our data and especially tracer ratios ($CH_4/^3He$ ~50×10^6 and CH_4/TDM ~4.5) reveal a transient CH_4 input, with elevated levels of CH_4 measured in 2010, that had vanished in 2011, most likely caused by an eruptive magmatic event. By contrast at Amanaki, vertical tracer profiles and tracer ratios point to typical seawater/basalt interactions. Fatu Kapa is characterised by a substantial spatial variability of the hydrothermal water column anomalies, most likely due to widespread focused and diffuse hydrothermal discharge in the area. In the Tasi Tulo zone, the hydrothermal signal is characterised by a total lack of turbidity, although other tracer anomalies are in the same range as in nearby Fatu Kapa. The background data set revealed the presence of a Mn and ^3He chronic plume due to the extensive and cumulative venting over the entire area. To that respect, we believe that the joined domain composed of our active area and the nearby active area discovered in the East by Lupton et al. (2012) highly contribute to the extensive Tonga-Fiji plume and which thus may not originate from a sole source near the Samoa. Our results also emphasize and support the idea that back-arc hydrothermal systems have a significant input to the regional and global ocean and maybe more important than their MOR analogues.

Publication Date: 8 August 2016 (online)
Available online:
http://www.sciencedirect.com/science/article/pii/S0967063715302004